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ROCK ISLAND, DAM SMOLT MONITORING, 1996

ANNUAL REPORT

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ABSTRACT

Downstream migrating salmon and steelhead (*Oncorhynchus* spp.) smolts were monitored at the Rock Island Dam bypass trap from April 1 - August 31, 1996. This was the twelfth consecutive year that the bypass-trap was monitored.

Data collected included:

- 1) number of fish collected by species,
- 2) number of fin clipped and/or Passive Integrated Transponder (PIT) tagged fish caught by species,
- 3) total number of fish showing signs of gas bubble trauma (GBT) ,
- 4) percent of descaled fish, and
- 5) daily average river flow, powerhouse #1 flow, powerhouse #2 flow and daily average spill.

These data were transmitted to the Fish Passage Center (FPC), which manages the Smolt Monitoring Program throughout the Columbia River Basin. The Smolt Monitoring Program is used to manage the "water budget", releasing upstream reservoir water storage allocated to supplement river flows during the downstream migration of juvenile salmonids.

The Rock Island Dam trapping facility collected 61 ,109 downstream migrating salmonids in 1996. Collected fish included nine previously PIT tagged fish.

Subsamples of yearling and/or sub-yearling chinook were examined for signs of Gas Bubble Trauma (GBT), a potentially lethal condition caused by high levels of dissolved gas supersaturation where dissolved gasses in the blood come out of solution and form bubbles in various tissues. Absence of presence and severity of GBT was recorded and reported to the Fish Passage- Center on Mondays, Wednesdays, and Fridays (daily when forebay dissolved gas levels exceeded 120%). Of the 4,946 yearling and sub-yearling chinook examined for signs of GBT, 1,549 (31.3%) showed some sign of GBT.

The middle 80% of the 1996 spring out-migration (excluding sub-yearling chinook) passed Rock Island Dam during a 44 day period, May 1 - June 13. Juvenile salmon and steelhead run timing is presented and compared to the average run timing for the most recent ten year period.

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INTRODUCTION

In 1982, The Northwest Power Planning Council developed a fish and wildlife program to protect, mitigate and enhance fish and wildlife resources affected by the construction and operation of the Columbia River hydroelectric facilities. This program established a "water budget" which allocated upstream water storage for instream flow supplementation to improve migration conditions for downstream migrating salmon (*Oncorhynchus* spp.) and steelhead (*O. mykiss*) on their journey to the Pacific Ocean. The plan also called for studies to monitor juvenile fish migration timing and survival.

The fisheries agencies and tribes formed a Water -Budget Center (ren'amed The Fish Passage Center (FPC)) to direct the use of the water budget and to conduct and coordinate studies related to water budget management and evaluation. The FPC developed a Smolt Monitoring Program (SMP) and selected several sites on the Columbia and Snake rivers as smolt monitoring stations. Rock Island Dam was selected as one of these smolt monitoring stations because it is the first dam downstream from all major salmon and steelhead producing tributaries of the mid-Columbia River (Figure 1).

The 1996 SMP at Rock Island Dam was designed to index the daily number of outmigrating salmon and steelhead and to report the numbers of adipose clipped and/or previously passive integrated transponder (PIT) tagged juvenile salmonids collected. A PIT tagging operation was implemented with a goal of tagging a random sample from the middle 80% of the outmigration of yearling chinook (*O. tshawytschal*, juvenile sockeye (*O. nerka*) and, steelhead. An additional goal of the PIT tagging operation was to tag up to 5,400 sub-yearling chinook.

A gas bubble trauma (GBT) monitoring program was implemented in 1996. A sub-sample of up to 100 chinook (either yearling or sub-yearling) was examined for signs of GBT on Monday, Wednesday and Friday throughout the season. Data collected under these programs allowed the comparison and evaluation of year to year migration timing and travel time of different species and races of juvenile salmonids, both naturally and hatchery produced.

U.S. National Biological Service personnel monitored ATPase levels to assess smolt condition for travel time analysis of downstream migrating salmonids. This was done by gill clipping subsamples of PIT tagged and run-of-the-river

f i s h ;

Funding of the program, as implemented by the FPC, was provided by the Bonneville Power Administration. (Public Utility District No. 1 of Chelan County (The District) provided the trapping facility, personnel and equipment to conduct the monitoring.

METHODS

Data collected daily at the Rock Island Dam bypass trap included:

1. total number of fish caught by species,
2. total number of fin clipped and/or PIT tagged fish caught by species,
3. total number of fish showing signs of GBT (Mon, Wed, Fri),
4. percent of descaled fish,
5. daily average river flow,
6. average river flow through powerhouse 1 and powerhouse 2 (Figure 2), and
7. daily average spill.

Now data were recorded so that an expanded index of fish passage through powerhouse 2 could be calculated based on the bypass collection count in relation to the proportion of total river flow passing through powerhouse 2.

Travel time between hatchery release points and the Rock Island Bypass Trap was estimated by PIT tagging Sub-samples of hatchery fish before release. Additionally, adipose and ventral fin clipped and coded wire tagged yearling chinook, subyearling chinook, steelhead and sockeye were counted.

The overall physical condition of fish trapped at the Rock Island Dam bypass trap was recorded daily. Qualifying the condition of fish was based on the degree of descale present. Fish with up to 20% scale loss per side were considered "OK", while fish with greater than 20% scale loss per side were recorded as "Descaled". The number of fish that perished within the trap, or after handling was also recorded daily:

Sub-samples of up to 100 yearling and/or subyearling chinook were examined using a variable magnification (6X to 40X) dissecting microscope for signs of GBT, including bubbles in the lateral line, unpaired fin's, and

around the eye. Fish were examined for GBT symptoms on alternating days (daily when dissolved gas levels in the river exceeded 120%). Absence or presence GBT symptoms and the severity and location of symptoms of GBT were recorded and reported to the FPC.

Fish were collected from the second powerhouse turbine intake gatewells and fishway attraction water intake. Fish entering the gatewells and attraction water intake passed into a bypass channel through a series of submerged orifices (Figure 3). An inclined screen trap separated the fish from the 100 cfs bypass flow and confined them to a holding flume where they were retained for up to 24 hours prior to sampling (Figure 4). All fish collected in the bypass flume were sampled.

Fish collected in the bypass flume over a 24 hour sampling period were crowded into an elevator hopper, raised to the upper deck of the dam and released into an aluminum holding tank which measured 12' x 4' x 3.5'. The holding tank was supplied with a continuous supply of river water by a 5 hp. submersible pump which was installed in the right bank fish ladder.

Before fish were dipped from the holding tank for sampling they were pre-anesthetized in an isolation chamber with a solution of Tricane Methane Sulfonate (MS. 222). Groups of 30 - 50 fish were then dip netted into a small flume that passed the fish into the sampling trailer. The fish were then further anesthetized using a stronger MS 222 solution. An ionic salt solution, ProPoly Aqua., was added to all fish handling tanks within the sampling trailer to reduce stress during handling and to enhance wound healing after the PIT tagging process. Periodic timing of the pre-anesthetization, identification, examination and recovery process was conducted to insure against overexposure to the anesthetic. All fish were identified to species and race and were scanned for PIT tags, clipped fins, and descale.

After the examined fish had fully recovered from the effects of the anesthesia, they were released through a 4" aluminum pipe from the recovery section of the tank (elevation 620' m.s.l.) to the tailrace (elevation 574' m.s.l.) (Figure 5). The release area of the tailrace was protected from gull (*Larus* spp.) predation with parallel lengths of stainless steel wire at above the pipe outlet and across the tailrace. In addition, employees from the U.S. Department of Agriculture's Animal Damage Control Division suppressed gull predation in the tailrace during the middle 80% of the spring outmigration by various behavior modifying techniques.

Fork length measurements and scale samples were taken three times per week from subsamples of sockeye. Steelhead were categorized as naturally or hatchery produced according to clipped adipose fin, or if an adipose fin

was present, a worn appearance of the dorsal and ventral fins (Peven and Hays, 1989). Hatchery produced steelhead released into Washington State waters since 1985 have been adipose clipped.

In addition to the smolt monitoring program, subsamples of chinook yearlings, wild and hatchery steelhead, and sockeye were injected with PIT tags each day between April 23 and May 31 (Table 1). Beginning June 24, sub-yearling summer and fall chinook were injected with PIT tags on daily basis until July 31 (Table 1). PIT tags were injected by hand using a medical syringe/pushrod mechanism with a 12 gauge veterinary needle attached. Syringes and needles were sterilized a minimum of 15 minutes in a bath of 95% ethanol prior to re-use. A random subsample of yearling chinook, sub-yearling chinook, steelhead and sockeye were PIT tagged daily. Data pertinent to the smolt monitoring program were transferred to the FPC in Portland, Oregon daily via a personal computer located at Rock Island Dam. A portion of the fish that were tagged at Rock Island Dam were "recaptured" at the McNary Dam bypass trap. Data obtained from fish tagged at Rock Island Dam and "recaptured" at McNary Dam were used to generate travel time estimates. The results of the 1996 PIT tagging program will be reported by the FPC.

Personnel from the National Biological Service monitored ATPase levels in yearling chinook, steelhead, and sockeye from April 23 - May 31. Subsamples of both PIT tagged (25% of sample) and run-of-the-river fish (75% of sample) were taken to assess the physiological condition of smolts for use in travel time analysis (Table 2). From June 24 - July 31, gill ATPase samples were taken from PIT tagged sub-yearling chinook three days a week (Table 2). The results of the sampling were reported to the FPC, providing additional data for managing the fish outmigration.

RESULTS AND DISCUSSION

FACILITY OPERATION AND HYDRAULIC INFORMATION

The Rock Island Dam bypass trapping facility operated without mechanical failure throughout the 1996 smolt monitoring program. The trapping facility collected 61,109 juvenile salmon and steelhead during the 1996 smolt monitoring program at Rock Island Dam (Appendix A). Hatchery fish collected with clipped adipose or ventral fins accounted for 9,267 yearling chinook, 1,399 subyearling chinook, 15,000 steelhead, 11,859 coho (all of hatchery origin), and 1,757 sockeye.

PIT tagging operations occurred at Rock Island Dam to provide migration timing rates for mid-Columbia juvenile salmonids. Table 1 summarizes the PIT tag marking program, listing the species tagged, rearing type, and number of fish tagged. Both spring and summer out-migrants were included.

Total river flow at Rock Island Dam during the peak period of salmonid outmigration was considerably higher than the twenty year average (Figure 6). An examination of daily powerhouse #2 turbine and spillway flows in proportion to total river flow showed a variance during the period of peak salmonid outmigration. Monthly average percent of total flow through Powerhouse #2 for the period of April 1 - June 30 ranged from 38.9% to 57.5% and daily averages ranged from 24.3% to 71.4%. Monthly average percent total flow through spill for the period of April 1 - June 30 ranged from 15.4% to 32.3% and daily averages ranged from 0.0% to 55.7% (Table 3).

High flows throughout the salmonid outmigration caused the large volumes of forced spill at mainstem hydroelectric dams upstream of Rock Island. Spill above Rock Island Dam caused the river to be super-saturated with dissolved atmospheric gasses and led to fish exhibiting signs of GBT. Examination of fish showed 54.8% (range 16.0%-98.0%) of the sample with signs of GBT in April, 32.3% (range 6.5%-74.0%) in May, 4.8% (range 0.0%-12%) in June, and 5.4% (range 0.0%-12.0%) in August when GBT sampling was discontinued (Figure 6).

There were differences observed in the abundance of chinook subyearlings, sockeye, and coho compared to the ten (eight for coho) year average. Actual collection counts for these three species were much lower than the ten-year average (Table 3). Comparisons of ten year average counts to actual collection counts showed slightly more chinook yearlings and steelhead were captured in 1996 than the ten year average.

There was little difference (2 - 3 days plus or minus) between the 10% and 90% passage dates and the ten year average for chinook yearlings and coho. However, the 10% and 90% passage dates for chinook subyearlings, steelhead, and sockeye were much (2 - 31 days) later than the ten year average (Table 4). All species (with the exception of coho) exhibited bimodal run timing in 1996 (Appendix B).

MIGRATION TIMING

Yearling Chinook

A total of 19,788 chinook yearlings were captured in the bypass trap in 1996 (Appendix A). Yearling chinook were present on April 1, (the first day of the smolt monitoring program) and continued to be present every day

through; July 5 (Appendix A, Figure B-1). The last yearling chinook was captured on August 17 (Appendix A). The 10% and 90% passage dates for yearling chinook were April 24 and June 7, respectively. Peak passage of 881 chinook yearlings occurred on May 21. A comparison of the 10%, 50%, and 90% passage dates of chinook yearlings in 1996 and the ten year average can be found in Table 4.

Sub yearling chinook

A total of 7,396 sub-yearling chinook was captured in the bypass trap in 1996 (Appendix A). Sub-yearling chinook were present on the first and last day of trap operations and were present on all -but eleven days throughout the 1996 smolt monitoring program (Appendix A, Figure B-2): The 10% and 90% passage dates for sub-yearling chinook were June 23 and August 11, respectively. Peak passage of 426 subyearling chinook occurred on June 29 (Appendix A). The 10%, 50% and 90% passage dates of chinook sub-yearlings in 1996 can be compared to the ten year average in Table 4.

Sockeye

A total of 4,664 sockeye was captured in the bypass trap in 1996 (Appendix A). Naturally produced sockeye comprised 62.3% of the total collected, with the remaining 37.7% coming from the Lake Wenatchee netpens of the dock Island hatchery complex or the Lake Osoyoos netpens of the Wells hatchery complex. Sockeye were collected on the first day of bypass operations, sockeye were present in the sample daily between April 10 and July 18, the last sockeye was collected on August 29. Peak passage of 155 sockeye occurred on May 3 (Appendix A, Figure B-3). The 10%, 50%, and 90% passage dates for 1996 can be compared to the ten year average in Table 4.

Juvenile sockeye bimodal run timing at Rock Island Dam has been observed in past years sampling and is a result of the two stocks of fish (Wenatchee and Okanogan) that pass the dam on their seaward migration. Wenatchee river outmigrants pass Rock Island primarily in April and Okanogan River smolts are more prevalent at Rock Island Dam in May (Peven 1987). The apparent trimodal distribution of sockeye run timing observed in 1996 may have been influenced by hatchery releases (Figure B-3).

Steelhead

A total of 17,402 downstream migrating steelhead was collected at the bypass trap in 1996 (Appendix A). Hatchery produced steelhead smolts totaled 15,000, comprising 86.2% of the total steelhead outmigration. Daily collection of steelhead smolts began on April 7 and continued until July 21, the last steelhead was collected at the Rock Island bypass trap on August 30. Peak passage of 702 steelhead occurred on May 19 (Figure B-4). The

10%, 50%, and 90% passage dates for 1996 can be compared to the ten year average in Table 4.

Coho

A total of 11,859 downstream migrating coho was collected in the bypass trap in 1996 (Appendix A). All coho were of hatchery origin. The first coho was collected at Rock Island on April 21, 1996 (Appendix A, Figure B-5). Daily collection of coho occurred, between April 27 and June 26, 1996, with the last coho captured at Rock Island Dam on August 11, 1996 (Appendix A).

Total salmonid run

A total of 61,109 juvenile salmonids was collected at the Rock Island bypass trap in 1996. The total salmonid run timing is represented in Appendix B-6. The peak passage count of 2,373 occurred on May 21 and was largely the result of 919 coho and 881 yearling chinook collected that day.

The effect of sub-yearling chinook on the 10%, 50% and 90% dates of the total juvenile migration was assessed. A comparison was made between the 1996 and previous ten year average (1986-1995) of the total, juvenile downstream migration past Rock Island Dam and of the migration excluding sub-yearling chinook.

The duration of the middle 80% of the total juvenile salmonid passage (10% date to 90% date) was 61 days (May 2 - July 1) with a 50% passage date on May 21. This was shorter (began and ended earlier) than the ten year average, although there was only a one day difference in the 50% passage date (Table 4). If subyearling chinook were excluded from this analysis, the middle 80% of the yearling salmonids would have passed Rock Island Dam during the 44 day period between May 1 and June 13 (Table 4). This compares to a 38 day duration for the ten year average with the middle 80% (of that ten year average) passing Rock Island Dam between April 24 and May 31. The 1996 migration of yearling and total salmonids past Rock Island Dam was considerably later and of shorter duration than the ten year average.

During the smolt monitoring program at Rock Island Dam this year we collected no Atlantic salmon (*Salmo salar*). A few of these fish have been collected in the Rock Island bypass trap in past years and are believed to be escapees from a netpen operation above Chief Joseph Dam (Fielder, 1995).

PIT TAG FISH RELEASE/RECAPTURE

Groups of PIT tagged hatchery fish totaling 16,954 fish were released into the Columbia River system upstream of Rock Island Dam. (Table 5). These fish were tagged at the U.S. Fish and Wildlife and Washington State Department of, Fish and Wildlife hatcheries. The, fish were then released to evaluate their travel time. These releases consisted of 5,386 yearling spring chinook, and 11,568 sub-yearling summer/fall chinook. A total of 9 previously PIT tagged fish was recaptured at Rock Island Dam in 1996. Of these recovered PIT tagged fish, 3 were yearling chinook from releases that totaled 5,386 fish (0.06% recovery rate). Four of the 11,568 PIT tagged sub-yearling chinook were recaptured at the Rock Island Dam trapping facility representing a recovery rate of 0.034%. One of the recaptured fish was a wild steelhead that had been previously tagged at Rock Island Dam. We assume that this fish ascended the adult fishway after tagging and then re-entered the bypass trap The remaining recaptured fish was a sockeye, the origin and tagging location of this fish is unknown.

SUMMARY

Between April 1 and August 31, 1996, 61,109 downstream 'migrating salmon and steelhead were collected at the Rock Island Dam bypass trap. Of this total, fish of hatchery origin (adipose or ventral fin clipped) accounted for 9,267 yearling chinook, 1,399 sub-yearling chinook, 15,000 steelhead, 11,859 coho, (all coho were of hatchery origin) and 1,757 sockeye. Fish of hatchery origin accounted for 64% of all fish sampled at Rock Island Dam in 1996.

The middle 80% of the salmonid outmig'ration passed Rock Island Dam between May 2 and July 1, 1996, a 61 day period. The 'dates and duration of the outmigration were extended by sub-yearling chinook in 1996. If sub-yearling chinook are excluded from the analysis, the middle 80% of the outmigration occurred between May 1 and June 13, 1996, a'-44 day period. Sub-yearling chinook comprised 12.1% of the fish collected at Rock Island Dam in 1996.

ACKNOWLEDGMENTS

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sampling. Chelan County P.U.D. personnel conducted the smolt monitoring at the Rock Island. bypass trap and a number of District employees assisted in the -study. Dick Nason and Steve Hays provided administrative and logistical support. Chuck Peven and Paul Fielder reviewed an earlier draft of this report. The- following individuals conducted the Smolt Monitoring Program, PIT tagging, and data input at the Rock Island Dam sampler: Osmond Heath, Barry Keese, Keith Truscott, Dave Beardsley, John Heller, Jeff Moser, James Bowen, Lisi Ott and Laura Horan.

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Peven, C. M. 1987. Downstream migration timing of two stocks of sockeye salmon on the mid-Columbia' River. Northwest Science 61: 186 - 190.

Table 1. PIT tag marking at Rock Island Dam bypass trap, April - August 1996.

Spring marking (April 23 - May 31, 1996)

Chinook	
Rearing	Number
Type	Released
Hatchery	
Unknown	4,828
Total	4,828

Steelhead	
Rearing	Number
Type	Released
Hatchery	3,410
Unknown	894
Total	4,304

Sockeye	
Rearing	Number
Type	Released
Hatchery	
Unknown	2,299
Total	2,299

Summer marking (June 24 - July 31, 1996)

Rearing	Number
Type	Released
Hatchery	
Unknown	4,170
Total	4,170

Table 2. Gill clipping and ATPase sampling of juvenile salmon and steelhead at Rock' Island Dam,' Spring and Summer 1996.

Species	Rearing Type	Dates sampled	Number Sampled
Chinook yearling	Hatchery	4/23/96 - 5/31/96	388
	Wild	4/23/96 - 5/31/96	409
Steel head	Hatchery	4/29/96 - 5/31/96	557
	Wild	4/29/96 - 5/31/96	136
Sockeye	Hatchery	4/29/96 - 5/31/96	173
	Wild	4/23/96 - 5/31/96	211
Chinook Sub-yearling	Hatchery	6/24/96 - 7/22/96	160
	Wild	6/26/96 - 7/31/96	310

Table 3. Rock Island Dam powerhouse operations expressed in KCFS and percent streamflow,
April 1 - August 31, 1996.

	Average KCFS				
	April	May	June	July	August
Total River Flow	182.0 (230.7 - 133.2)	204.2 (145.1 - 244.4)	225.0 (181.6 - 260.0)	181.1 (119.2 - 215.8)	141.8 (99.2 - 178.4)
Powerhouse #1	48.5 (19.8 - 66.0)	51.7 (18.6 - 65.3)	62.5 (49.7 - 73.1)	55.3 (5.2 - 74.0)	38.8 (3.8 - 64.0)
Powerhouse #2	102.3 (90.4 - 115.8)	98.1 (81.4 - 116.9)	86.5 (62.0 - 102.3)	85.3 (62.6 - 102.5)	79.1 (61.4 - 93.6)
Spill	29.9 (0.0 - 61.8)	52.9 (17.4 - 107.0)	74.5 (32.2 - 139.5)	38.7 (17.1 - 47.6)	22.9 (12.4 - 47.7)
Average percent of total flow					
Powerhouse #1	26.3 (8.4 - 32.5)	25.3 (9.1 - 35.1)	28.2 (19.4 - 35.7)	29.6 (4.4 - 38.6)	26.7 (3.1 - 38.1)
Powerhouse #2	57.5 (45.0 - 71.4)	48.9 (36.6 - 65.0)	38.9 (24.3 - 48.0)	47.2 (42.0 - 54.6)	56.5 (46.4 - 71.2)
Spill	15.4 (0.0 - 26.8)	25.0 (9.5 - 48.6)	32.3 (17.2 - 55.7)	22.1 (9.7 - 39.7)	16.2 (8.4 - 39.5)

* Monthly ranges appear in parenthesis

Table 4. Comparison of 1996 collection counts and the 10 year average of collection counts for passage dates for the Rock Island bypass trap, 1996.

Species		Totals	Number			10%
			10%	50%	90%	
Chinook yearlings	1996	19,788	1,718	8,592	15,466	24-Apr
	10 year avg.	17,185	1,718	8,592	15,466	22-Apr
Chinook sub-yearlings	1996	7,396	740	3,698	6,656	23-Jun
	10 year avg.	22,079	2,208	11,039	19,871	3-Jun
Steelhead	1996	17,402	1,740	8,701	15,662	5-May
	10 year avg.	17,176	1,718	8,588	15,458	3-May
Sockeye	1996	4,664	466	2,332	4,198	23-Apr
	10 year avg.	13,727	1,373	6,863	12,354	17-Apr
Coho	1996	11,859	1,186	5,930	10,673	14-May
	8 year avg.	24,745	2,475	12,373	22,271	15-May
Total yearlings	1996	53,713	5,371	26,857	48,342	1-May
	10 year avg.	67,862	6,786	33,931	61,075	24-Apr
Total salmonids	1996	61,109	6,111	30,555	54,998	2-May
	10 year avg.	89,941	8,994	44,971	80,947	27-Apr

10 Year average includes 1986 - 1995 but does not include 1996.

• 8 year average includes 1986 - 1993, there were no coho released in the mid-Columbia

Table 5. PIT tagged juvenile chinook salmon released upstream from Rock Island Dam in 1996.

Hatchery release site	Agency	Race	Number Released
Chiwawa Ponds	WA. Dept. F&W	Spring	1,497
Entiat	US F&W Service	Spring	1,200
Leavenworth	US F&W Service	Spring	1,196
Winthrop	US F&W Service	Spring	1,493
Carlton Pond	WA. Dept. F&W	Summer	1,500
Dryden Pond	WA. Dept. F&W	Summer	1,592
Similkameen Pond	WA. Dept. F&W	Summer	1,499
Wells	US F&W Service	S u m m e r	4,481
Turtle Rock	WA. Dept. F&W	Fall	2,296
Total			16,954

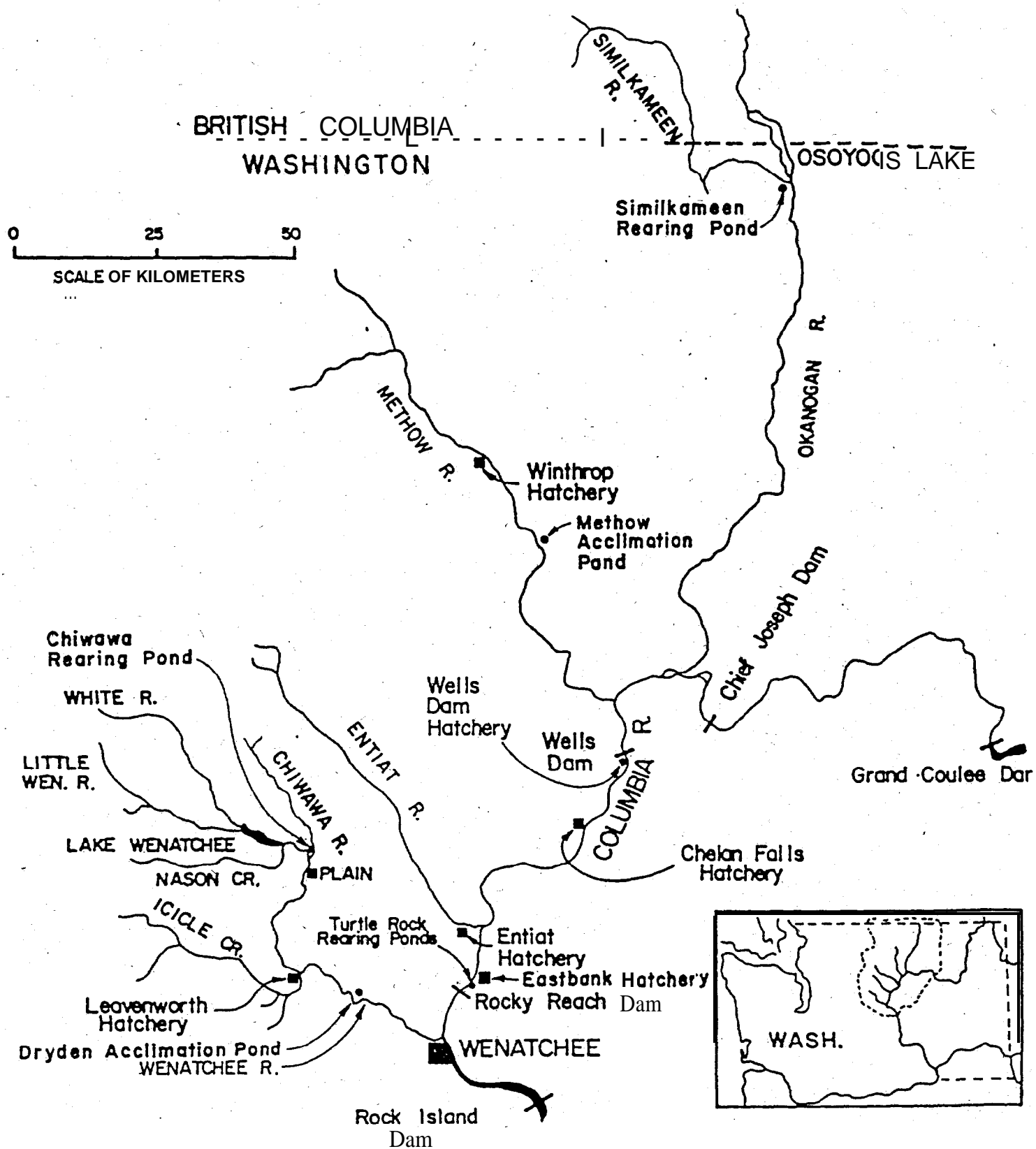


Figure 1. Columbia River between Rock Island and Grand Coulee dams showing major tributaries and hatcheries.

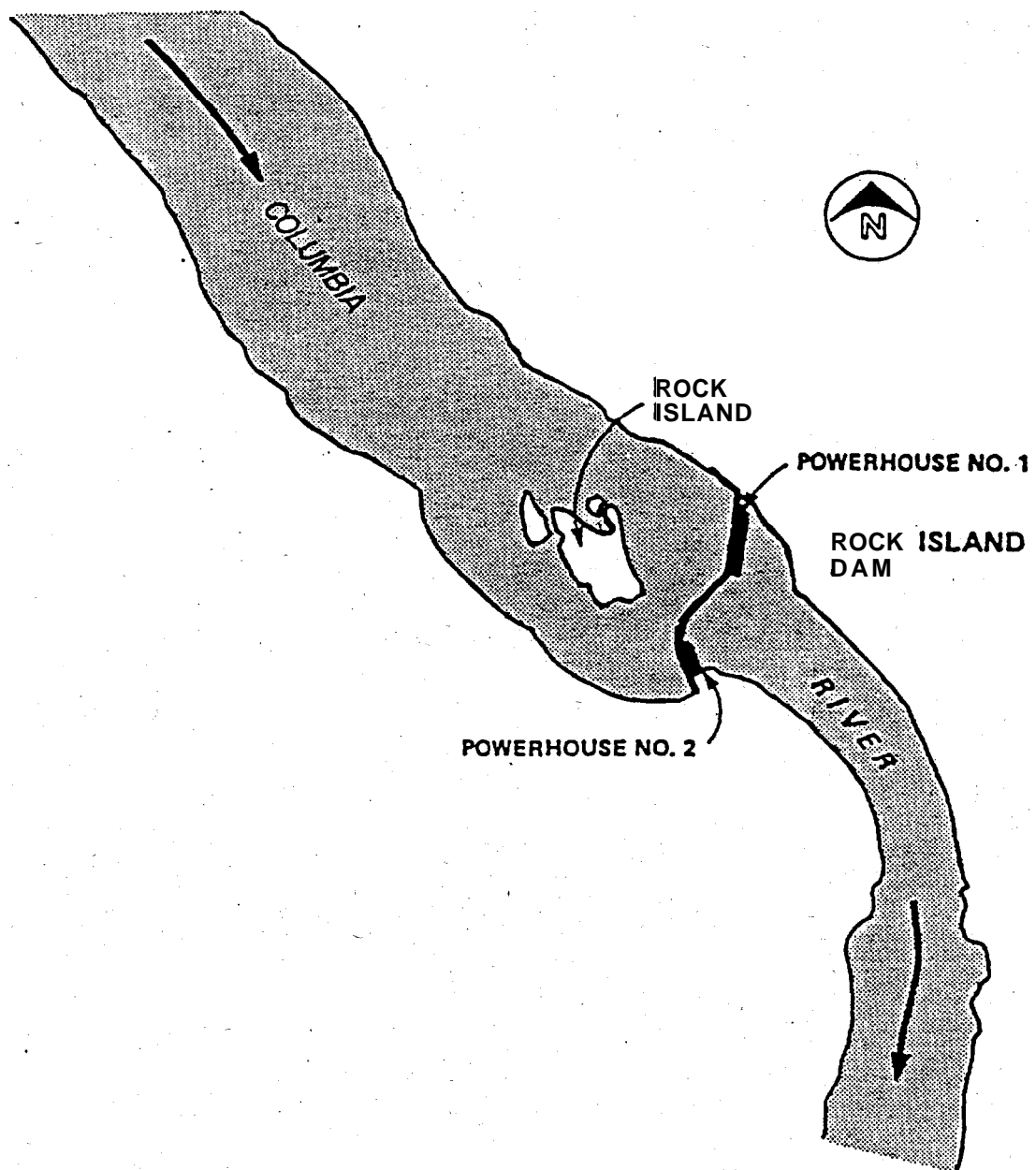


Figure 2. Location of powerhouse #1 and powerhouse #2 of Rock Island hydroelectric project.

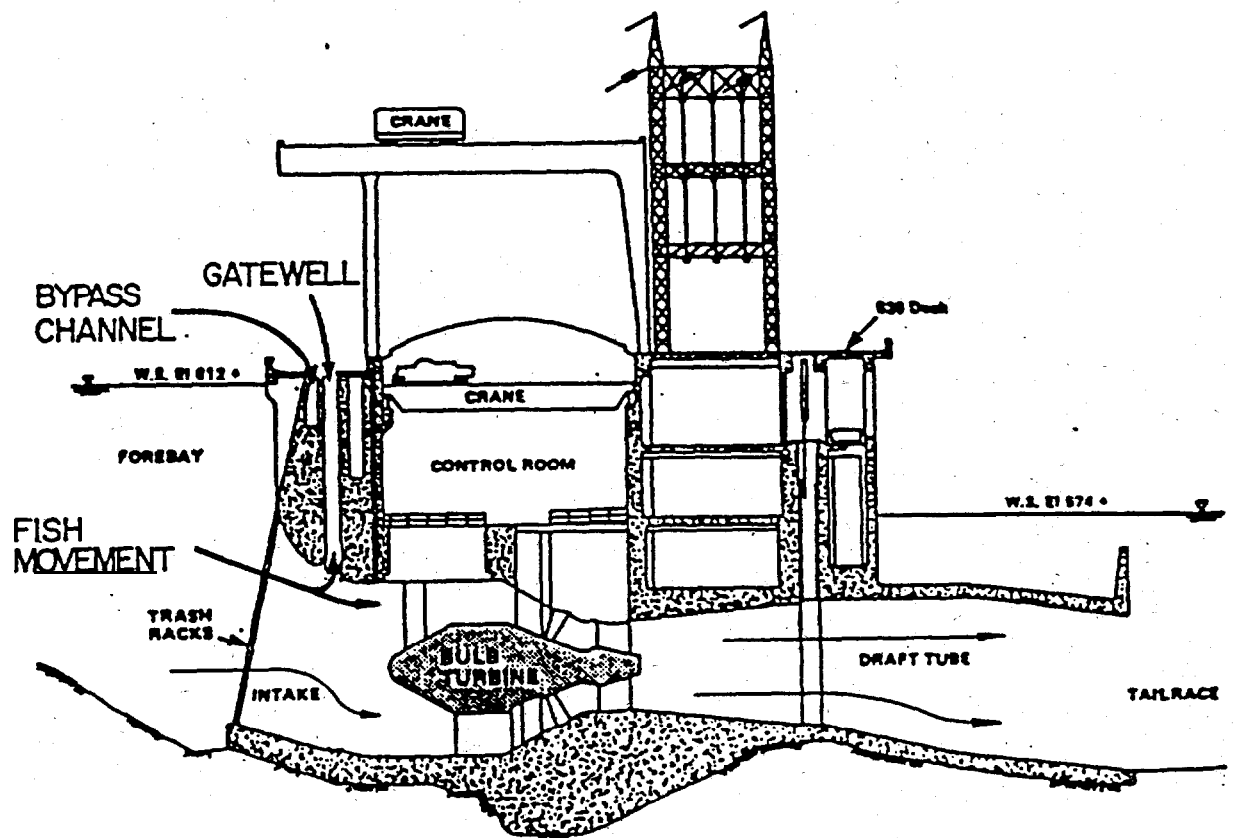


Figure 3. Section through Rock Island Dam second powerhouse indicating fish movement into gatewell system.

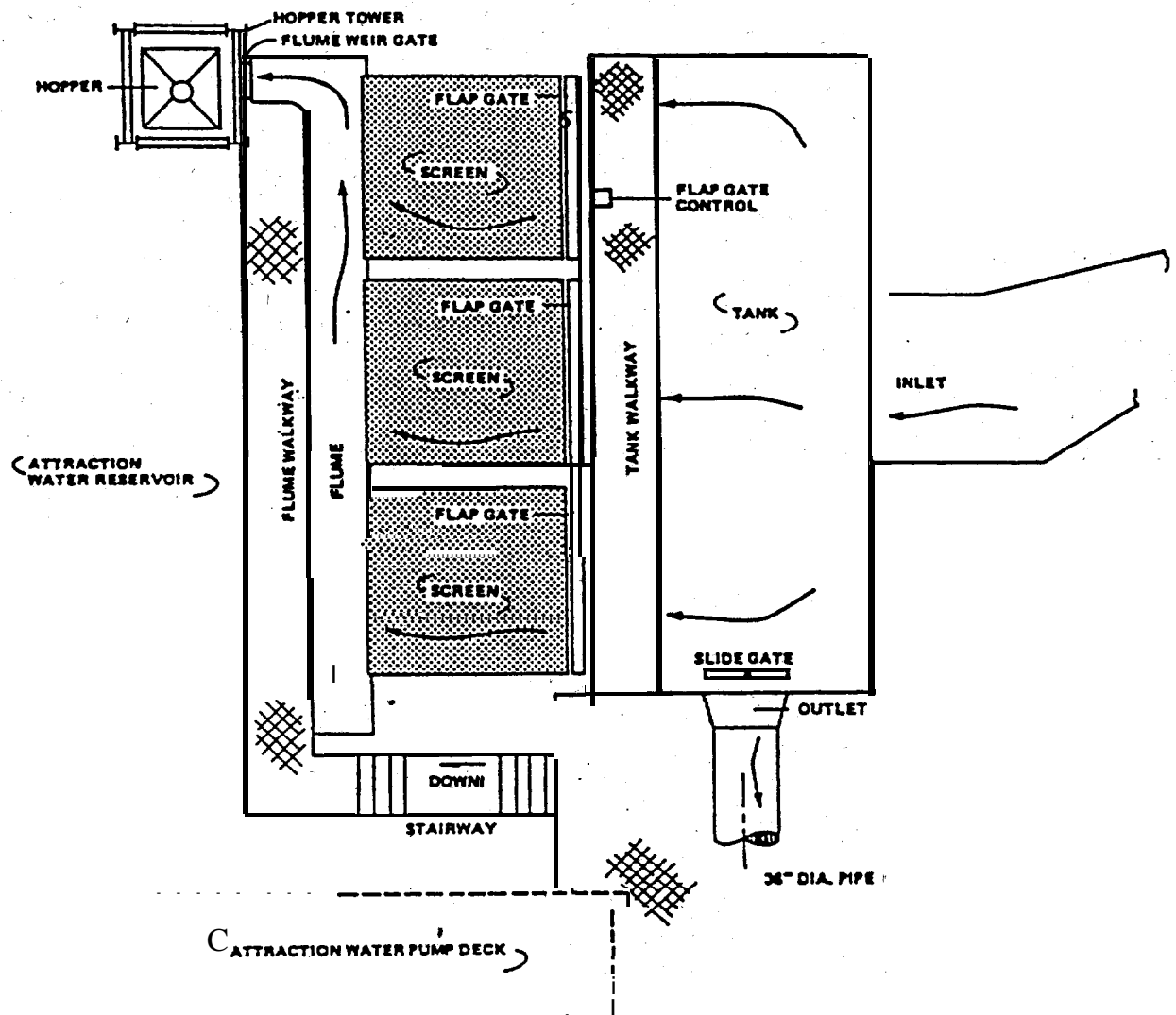


Figure 4. Rock Island Dam juvenile salmonid fingerling collection trap.

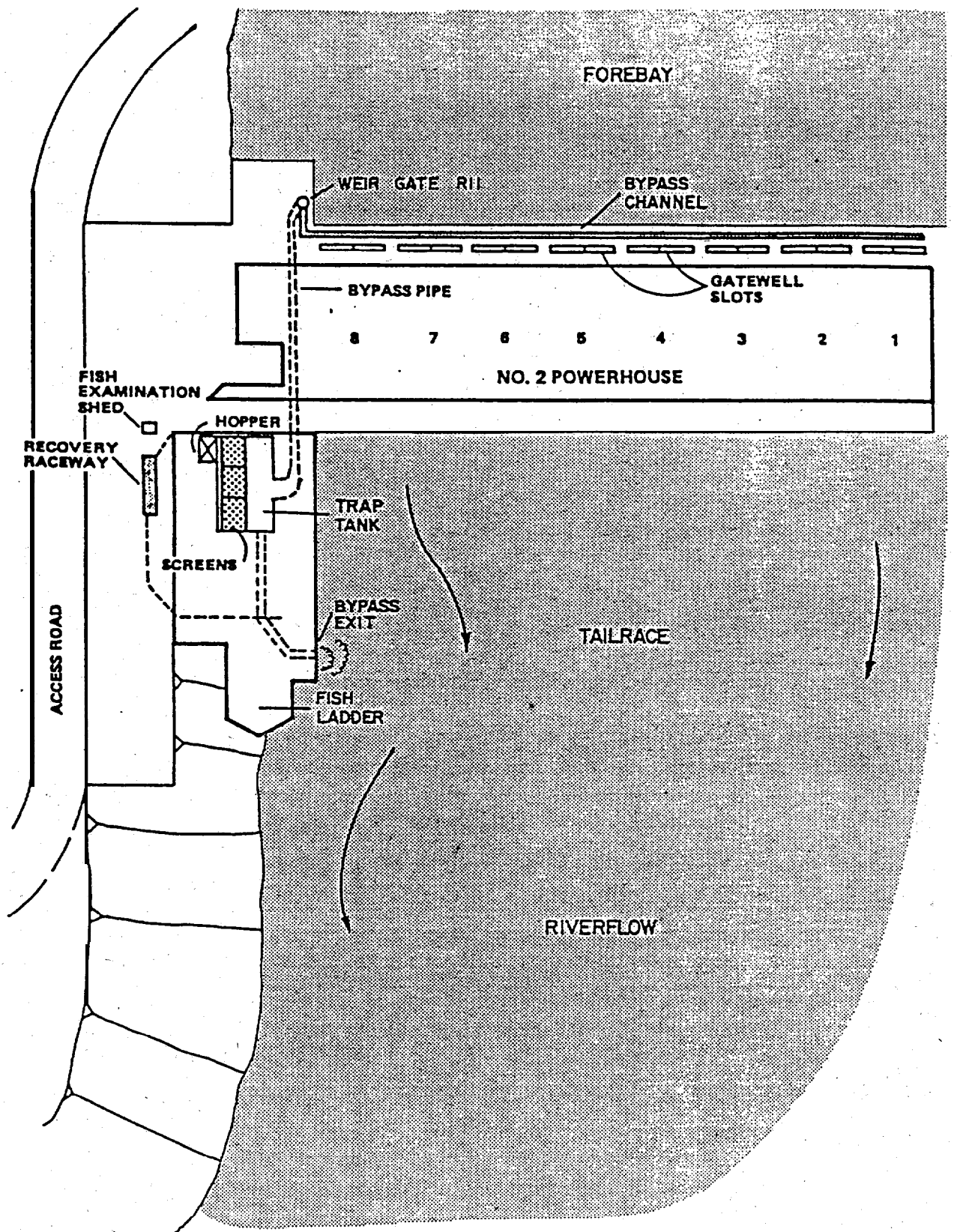


Figure 5. Plan view of juvenile salmonid bypass and collection system at Rock Island Dam second powerhouse (taken from Olson 1983).

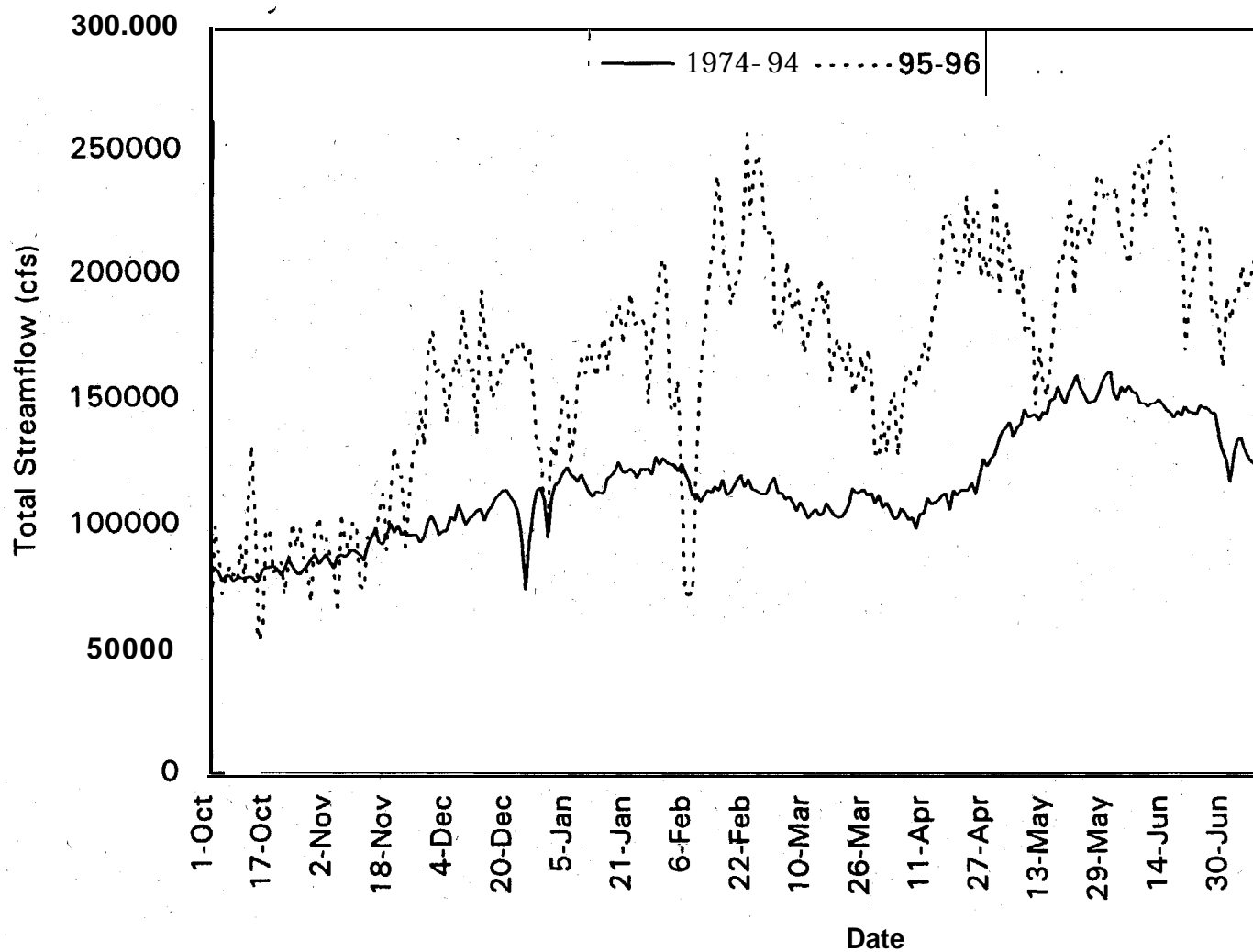


Figure 6. Comparison of 1996 total streamflow at Rock Island Dam to the twenty year average.

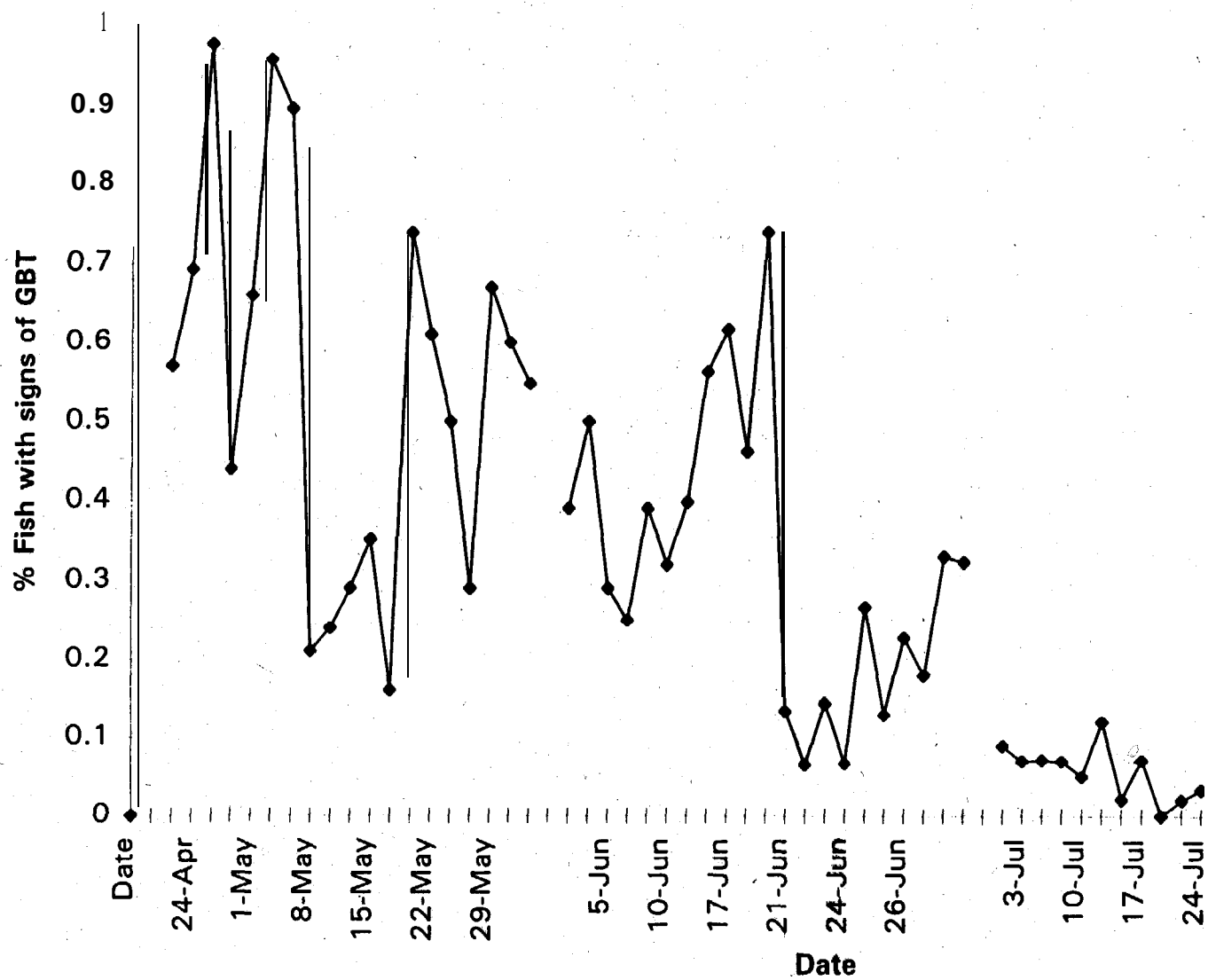


Figure 7. Percent GBT observed in fish collected at Rock Island Dam bypass trap, April August 1996.

Appendix A

Daily Salmonid collections, Rock Island Dam bypass trap,

April 1 - August 31, 1996.

Appendix A -1. Daily Salmonid collections, Rock Island bypass trap, April 1996

DATE	TOTAL	RI 2	CH 1		CHO		STEELHEAD		COHO	SCKEYE		TOTAL	TOTAL
	STFLOW	FLOW	WILD	HATCH	WILD	HATCH	WILD	HATCH		WILD	HATCH	SALMON	YRLNG
4/1/96	133.2	92.2	5	0	2	0	0	0	0	1	0	8	6
4/2/96	137.9	98.4	3	0	4	0	0	0	0	0	0	7	3
4/3/96	142.6	96.4	36	22	0	0	0	0	0	0	1	59	59
4/4/96	148.8	96.9	36	26	3	0	0	0	0	0	0	65	62
4/5/96	142.7	99.8	20	39	2	0	0	0	0	0	0	61	59
4/6/96	136.2	94.9	13	22	4	0	0	0	0	1	0	40	36
4/7/96	152.1	97.4	7	90	6	0	1	0	0	0	0	104	9 8
4/8/96	157.4	96.3	5	53	14	0	0	1	0	0	0	73	59
4/9/96	157.7	90.4	6	25	20	0	6	0	0	0	0	57	37
4/10/96	153.3	100.1	9	32	14	0	4	0	0	3	0	62	48
4/11/96	156.8	102.3	8	33	18	0	5	0	0	5	0	69	51
4/12/96	171.1	100	8	31	10	0	2	0	0	11	0	62	52
4/13/96	176	105.8	11	41	4	0	10	2	0	14	0	82	78
4/14/96	165.8	106.2	12	54	7	0	8	1	0	15	0	97	90
4/15/96	188.7	108.7	11	52	11	0	7	0	0	20	0	101	90
4/16/96	191.1	94.5	32	61	6	0	7	21	0	10	0	137	131
4/17/96	205	94.9	229	87	9	0	9	10	0	4	0	348	339
4/18/96	222.1	108.3	146	79	8	0	6	27	0	15	0	281	273
4/19/96	223.4	111.3	92	64	7	0	5	3 2	0	20	0	220	213
4/20/96	223.9	115.8	58	43	4	0	6	30	0	86	0	227	223
4/21/96	202.2	105.6	45	58	3	0	9	29	1	91	4	240	237
4/22/96	196.7	108.7	57	76	5	0	7	25	0	91	9	270	265
4/23/96	203.6	105.8	54	66	12	0	11	27	0	88	2	260	248
4/24/96	230.7	103.9	63	48	5	0	7	38	5	42	1	209	204
4/25/96	215.4	103.8	70	90	8	0	10	35	8	26	1	248	240
4/26/96	224.2	64.5	52	53	2	0	12	39	0	65	3	226	224
4/27/96	208.9	105	54	42	11	0	15	51	1	9	5	268	2 5 7
4/28/96	201.4	104.8	82	59	18	0	18	86	7	75	3	348	330
4/29/96	209.1	107.6	120	101	2	0	21	87	14	117	5	467	465
4/30/96	201.4	108.3	112	113	4	0	30	109	15	93	18	494	490
Total			1456	1560	223	0	216	650	51	982	52	5190	4967

Appendix A-2. Daily Salmonid Collections, Rock Island bypass trap, May 1996.

DATE	TOTAL STFLOW	RI 2 FLOW	CH 1		CHO		STEECHEAD		COHO	SOCKEYE		TOTAL SALM.	TOTAL YRLNG.
			WILD	HATCH	WILD	HATCH	WILD	HATCH.		WILD	HATCH		
5/1/96	239.3	111.57	141	94	4	1	20	147	24	109	10	550	545
5/2/96	208.46	64.53	127	77	8	0	27	134	27	88	11	499	491
5/3/96	196.21	105.99	150	139	5	0	25	193	57	127	28	724	719
5/4/96	216.37	109	220	179	6	0	44	170	53	80	24	776	770
5/5/96	219.28	107.44	190	118	3	0	32	233	23	63	23	685	682
5/6/96	199.2	101.47	194	103	2	0	23	207	42	41	13	625	623
5/7/96	195.11	109.57	142	114	3	0	25	216	62	36	16	614	611
5/8/96	205.33	116.87	170	122	0	0	32	234	39	22	13	632	632
5/9/96	194.5	111.45	226	182	0	0	49	324	87	41	15	924	924
5/10/96	164.25	87.78	166	110	0	0	21	253	107	33	18	708	708
5/11/96	187.24	94.16	221	184	1	0	32	304	113	25	12	892	892
5/12/96	166.58	99.08	244	225	0	0	26	374	139	24	19	1051	1051
5/13/96	145.06	93.86	197	206	4	0	35	302	172	23	21	960	956
5/14/96	161.76	90.48	315	290	1	0	31	389	312	31	45	1414	1413
5/15/96	162.03	96.52	311	328	1	0	34	386	397	36	50	1543	1542
5/16/96	153.24	99.53	248	314	1	0	61	368	506	26	43	1567	1566
5/17/96	177.49	104.58	354	413	2	0	67	438	584	26	78	1962	1960
5/18/96	198.76	107.73	307	446	0	0	65	514	592	29	52	2005	2005
5/19/96	204.54	96.75	250	324	0	0	95	607	728	40	71	2115	2115
5/20/96	213.2	103.57	170	281	0	0	81	490	785	33	51	1891	1891
5/21/96	220.62	93.84	328	553	1	0	75	378	919	41	78	2373	2372
5/22/96	231.01	92.67	267	454	2	0	57	255	577	39	75	1726	1724
5/23/96	222.81	87.07	148	256	0	0	53	208	454	37	38	1194	1194
5/24/96	222.73	89.33	190	269	3	0	43	213	582	48	49	1397	1394
5/25/96	227.07	87.42	199	315	0	0	35	236	440	30	78	1333	1333
5/26/96	205.74	92.68	165	288	1	0	25	222	594	27	71	1393	1392
5/27/96	220.47	81.41	122	224	1	0	14	199	590	16	66	1232	1231
5/28/96	224.95	87.23	129	196	1	0	32	292	478	28	75	1231	1230
5/29/96	244.38	91.07	67	92	1	0	21	199	292	23	29	724	723
5/30/96	228.08	89.75	56	111	2	0	25	228	276	16	40	754	752
5/31/96	229.99	84.23	84	122	8	0	28	232	309	13	33	829	821
Total			6098	7129	61	1	1233	8945	10360	1251	1245	36323	36261

Appendix A-3. Daily Salmonid Collections, Rock Island bypass trap, June 1996.

DATE	TOTAL STFLOW	RI 2 FLOW	CH 1		CHO		STEELHEAD		COHO	SOCKEYE		TOTAL SALM.	TOTAL YRLNG.
			WILD	HATCH	WILD	HATCH	WILD	HATCH		WILD	HATCH		
6/1/96	233.33	83.2	74	128	1	0	76	195	300	12	28	814	813
6/2/96	234.13	86.77	67	124	2	0	22	158	187	7	20	587	585
6/3/96	224.78	86.86	89	148	5	0	28	185	161	13	30	659	654
6/4/96	229.95	90.39	94	130	5	0	34	167	151	8	11	600	595
6/5/96	218	83.53	90	166	5	0	18	144	151	13	19	606	601
6/6/96	216.54	90.61	97	164	8	0	36	173	88	10	19	595	587
6/7/96	201.69	86.85	134	205	19	0	32	170	98	2	13	673	654
6/8/96	224.72	91.3	177	221	56	0	45	150	89	11	23	772	716
6/9/96	249.09	60.69	100	145	44	0	31	116	51	11	9	507	463
6/10/96	234.1	87.37	53	62	9	0	14	96	29	10	2	275	266
6/11/96	230.3	88.8	53	73	a	0	31	211	20	6	3	405	397
6/12/96	232.9	90.08	53	40	5	0	42	354	42	5	7	548	543
6/13/96	256.43	86.45	42	46	2	0	32	418	15	13	17	585	583
6/14/96	246.58	88.13	31	33	8	0	29	411	9	4	3	528	520
6/15/96	248.5	82.7	32	41	6	0	38	362	13	8	25	525	519
6/16/96	253.07	60.5	25	39	3	0	17	236	10	5	10	345	342
6/17/96	260.02	66.96	25	48	5	0	16	239	3	4	18	358	353
6/18/96	253.75	86.84	23	64	6	14	11	267	6	19	23	433	413
6/19/96	235.1	86.6	20	88	3	0	27	196	8	13	4	359	356
6/20/96	216.29	89.08	15	23	4	79	16	182	5	8	9	341	258
6/21/96	216.23	90.33	25	21	46	5	103	17	1	9	9	236	185
6/22/96	192.86	63.73	15	7	7	46	10	108	3	7	a	211	158
6/23/96	181.56	81.29	10	6	6	48	7	159	1	1	2	257	203
6/24/96	190.09	64.88	9	11	8	29	24	88	2	11	1	183	146
6/25/96	202.34	96.6	8	11	10	27	23	93	1	30	0	203	166
6/26/96	215.61	92.83	10	7	17	33	10	66	1	26	4	174	124
6/27/96	218.46	85.55	6	a	12	21	18	48	0	12	3	128	95
6/28/96	216.23	72.45	4	6	212	71	40	18	1	13	26	391	108
6/29/96	210.72	93.82	2	11	326	100	16	61	0	38	5	559	133
6/30/96	187.16	86.63	1	23	197	76	14	52	0	36	5	404	131
												0	0
TOTAL			1384	2099	1045	549	860	5140	1446	376	362	13261	11667

Appendix A-4. Daily Salmonid Collections, Rock Island bypass trap, July 1996.

DATE	TOTAL STFLOW	RI 2 FLOW	CH 1		CHO		STEELHEAD		C O H O		SCKEYE		TOTAL. SALM.	TOTAL YRLNG.
			WILD	HATCH	WILD	HATCH	WILD	HATCH.			WILD	HATCH		
7/1/96	175.98	89.51	9	8	131	101	9	40	0		41	2	341	109
7/2/96	177.24	79.65	2	0	102	110	13	48	0		37	11	323	111
7/3/96	169.56	77.99	5	4	88	90	14	24	0		52	10	287	109
7/4/96	188.75	87.99	1	2	86	80	2	26	0		39	16	252	86
7/5/96	176.19	78.18	0	0	39	59	8	15	1		20	10	152	54
7/6/96	194.65	98.37	0	0	68	64	3	14	0		8	10	187	35
7/7/96	198.24	97.95	0	0	55	45	7	22	0		14	4	147	47
7/8/96	196.73	83.35	1	1	82	68	6	11	0		11	7	187	37
7/9/96	196.74	90.57	0	2	95	40	3	1	0		11	5	157	22
7/10/96	200.29	85.98	2	0	115	30	1	3	0		10	0	161	16
7/11/96	208.02	102.51	0	3	220	25	5	8	0		9	3	273	28
7/12/96	215.77	71.36	2	1	199	43	3	7	0		5	0	260	18
7/13/96	212.61	100.63	0	0	107	25	0	2	0		3	1	138	6
7/14/96	207.25	89.64	0	0	69	10	0	3	0		5	2	89	10
7/15/96	199.36	92.5	0	0	96	5	1	4	0		3	0	109	8
7/16/96	199.43	93.5	0	1	116	5	3	4	0		2	1	132	11
7/17/96	179.09	83.8	1	1	73	5	1	5	0		2	2	90	12
7/18/96	182.1	83.71	0	0	53	5	1	7	0		0	0	66	8
7/19/96	198.08	97.97	0	0	36	2	1	4	0		0	0	43	5
7/20/96	176.7	79.57	0	0	19	0	1	1	0		1	2	24	5
7/21/96	169.1	79.9	0	0	62	1	0	0	0		2	1	66	3
7/22/96	171.19	84.86	0	2	123	6	1	1	0		2	1	136	7
7/23/96	189.17	83.69	0	0	82	2	2	1	0		0	0	87	3
7/24/96	197.11	97.18	0	1	86	4	1	0	0		2	0	94	4
7/25/96	170.14	60.8	0	0	101	6	1	1	0		0	0	109	2
7/26/96	177.73	83.43	0	0	125	4	0	1	0		3	0	133	4
7/27/96	163.63	72.94	0	1	77	2	0	1	0		1	0	82	3
7/28/96	128.96	62.61	0	0	111	2	0	0	0		1	1	115	2
7/29/96	119.17	65.1	0	1	94	2	1	0	0		3	0	101	5
7/30/96	137.83	71.05	0	2	61	1	1	1	0		2	0	68	6
7/31/96	160.23	77.98	0	1	91	1	0	1	0		1	0	95	3
TOTAL			23	31	2882	843	89	256	1		290	89	4504	779

Appendix A-5. Daily Salmonid Collections, Rock Island bypass trap, August 1996.

DATE	TOTAL	RI 2	CH 1		C H O		STEELHEAD		COHO	SOCKEYE		TOTAL	TOTAL
	STFLOW	FLOW	WILD	HATCH	WILD	HATCH	WILD	HATCH.		WILD	HATCH	SALM.	YRLNG.
8/1/96	162.92	81.16	0	0	90	2	0	2	0	2	2	98	6
8/2/96	151.47	76.68	0	1	95	0	0	0	0	1	0	97	2
8/3/96	121.98	62.1	0	0	70	0	0	1	0	0	0	71	1
8/4/96	120.8	67.8	0	0	101	0	0	1	0	0	0	102	1
8/5/96	163.1	83.63	0	2	103	1	0	1	0	0	0	107	3
8/6/96	166.05	77	0	1	76	1	0	2	0	0	0	80	3
8/7/96	178.4	87.13	0	0	73	1	0	0	0	0	0	74	0
8/8/96	174.1	88.83	0	0	68	0	0	0	0	1	1	70	2
8/9/96	157.79	84.87	0	0	91	0	0	0	0	0	0	91	0
8/10/96	157.36	82.98	0	1	224	0	0	0	0	0	3	228	4
8/11/96	139.48	82.33	0	0	189	1	0	1	1	0	3	195	5
8/12/96	140.07	72.89	0	2	88	0	0	0	0	1	1	92	4
8/13/96	154.26	81.03	0	0	61	0	1	0	0	0	1	63	2
8/14/96	163.38	88.9	0	0	59	0	0	0	0	0	0	59	0
8/15/96	175.7	93.6	0	0	67	0	0	0	0	0	0	67	0
8/16/96	152.9	78.1	0	0	44	0	0	1	0	0	0	45	1
8/17/96	133.6	77.7	0	1	40	0	1	0	0	0	0	42	2
8/18/96	128.5	81.3	0	0	21	0	0	0	0	0	0	21	0
8/19/96	131.1	85	0	0	25	0	0	0	0	0	0	25	0
8/20/96	156.4	88.8	0	0	11	0	0	0	0	0	0	11	0
8/21/96	156.1	85.1	0	0	28	0	0	0	0	0	0	28	0
8/22/96	137.7	79.5	0	0	20	0	0	0	0	0	0	20	0
8/23/96	99.2	61.4	0	0	16	0	0	0	0	0	0	16	0
8/24/96	101.1	71.9	0	0	24	0	0	0	0	0	0	24	0
8/25/96	115.9	73.1	0	0	21	0	0	0	0	0	0	21	0
8/26/96	115.9	73.1	0	0	20	0	1	0	0	0	0	21	1
8/27/96	119	68.8	0	0	9	0	0	0	0	0	0	9	0
8/28/96	143.7	81.1	0	0	13	0	0	0	0	0	0	13	0
8/29/96	125.3	80.1	0	0	10	0	0	0	0	0	1	11	1
8/30/96	131.5	84.4	0	0	24	0	1	0	0	0	0	25	1
8/31/96	106	64.7	0	0	5	0	0	0	0	0	0	5	0
TOTAL			0	8	1786	6	4	9	1	5	12	1831	39

Appendix B

Daily juvenile salmonid run timing for 1996

and the ten year average.

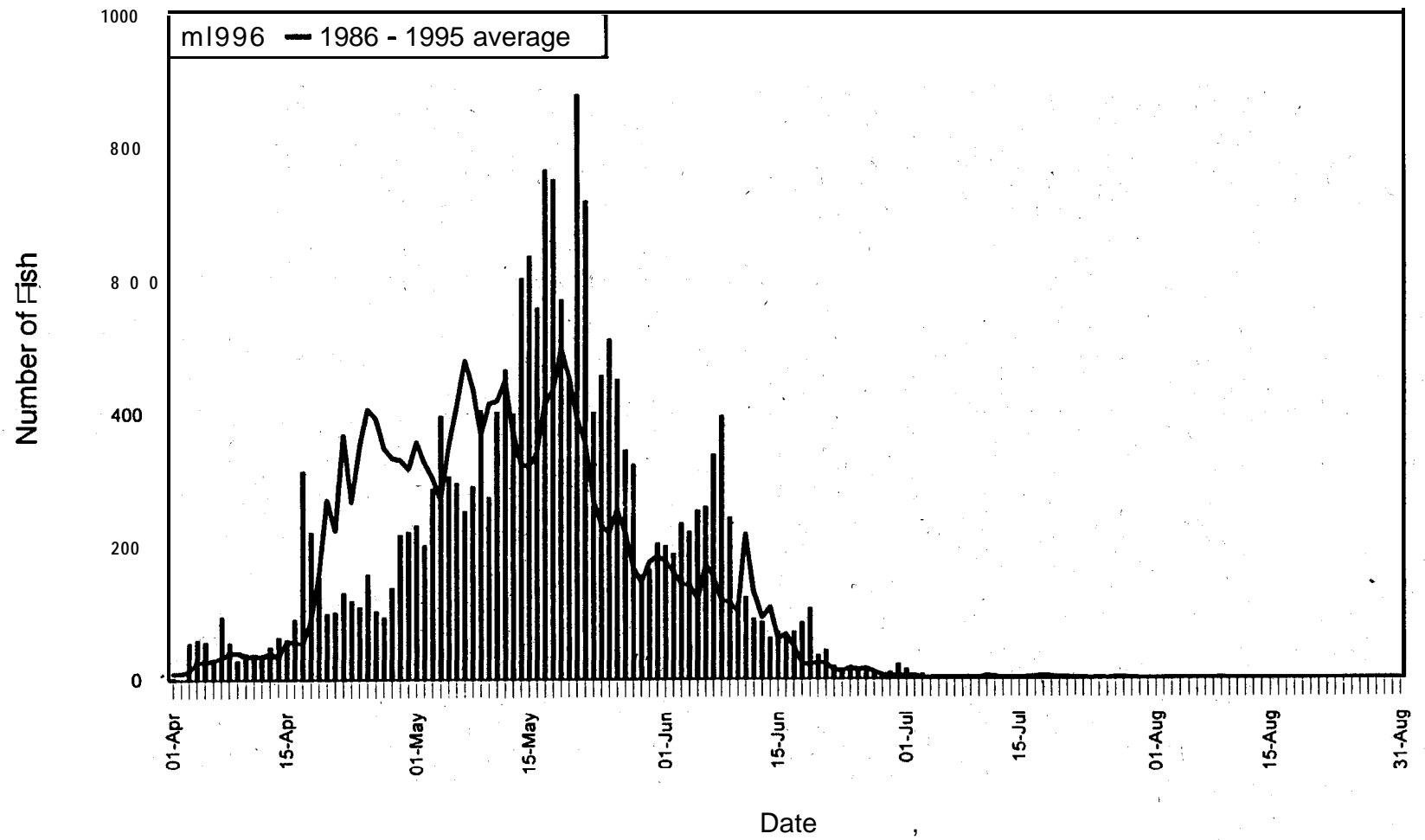


Figure B-I, Daily collection of yearling chinook at Rock Island Dam

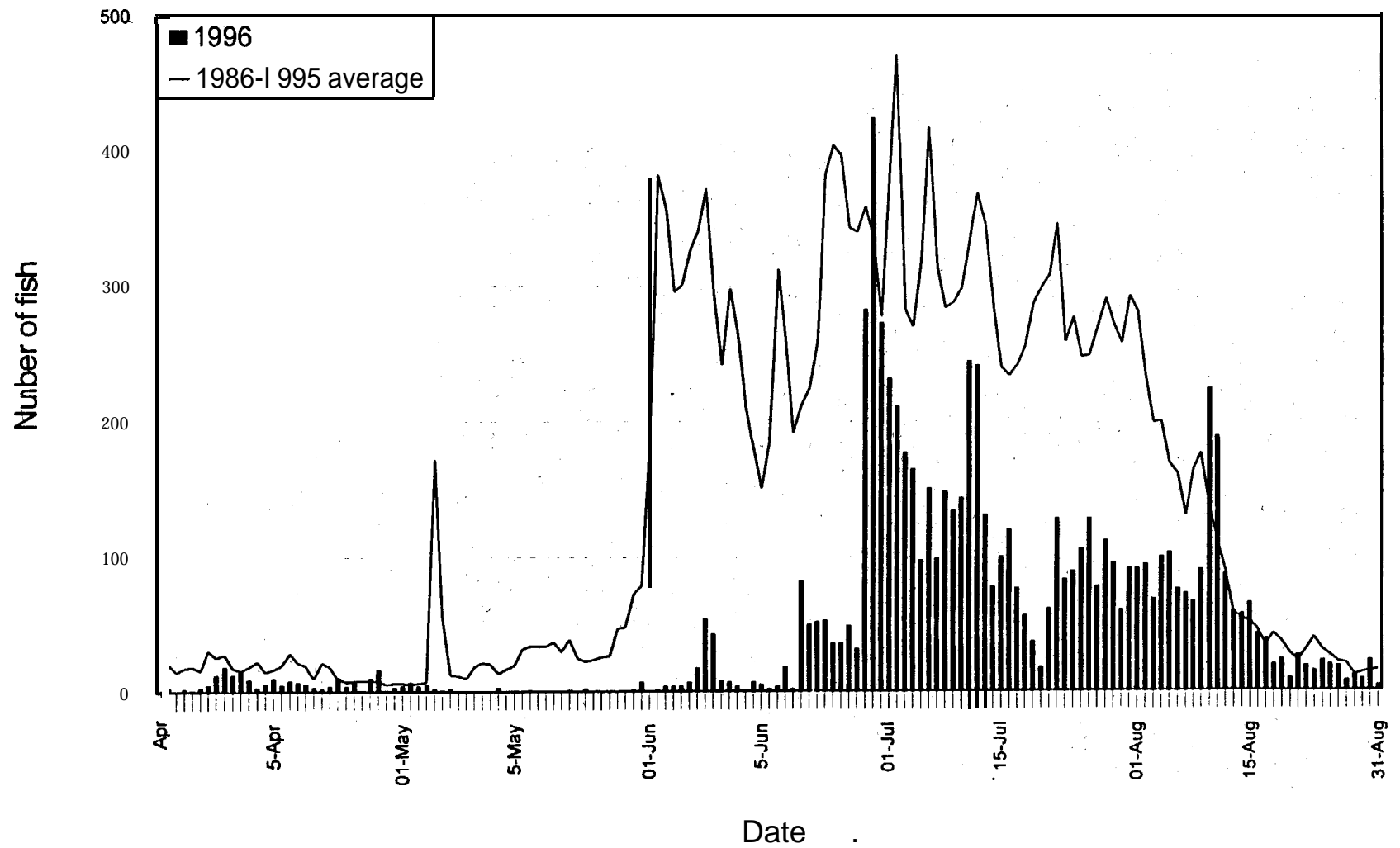


Figure B-2. Daily collection of sub-yearling chinook at Rock Island Dam

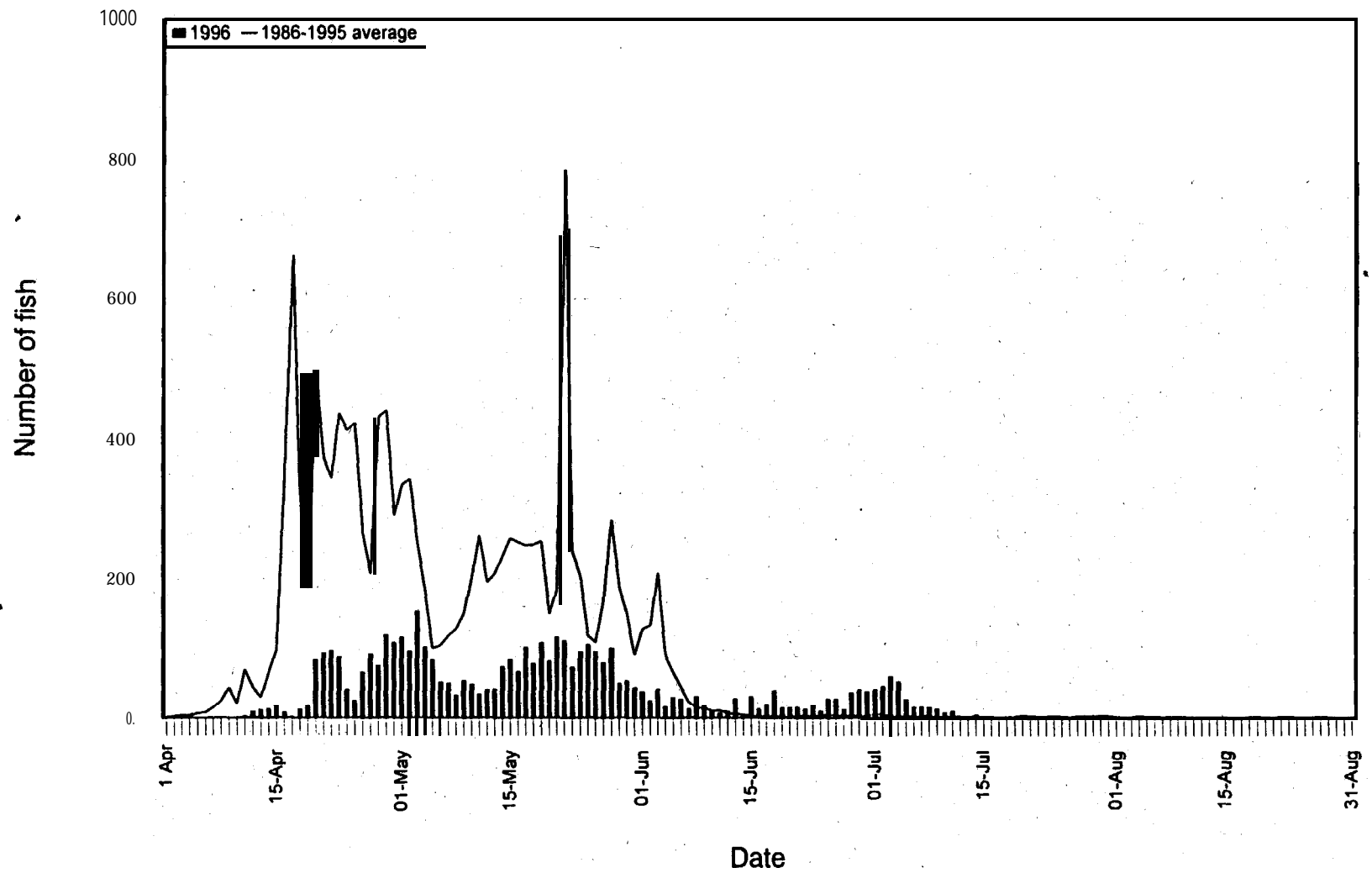


Figure B-3. Daily collection of sockeye at Rock Island Dam.

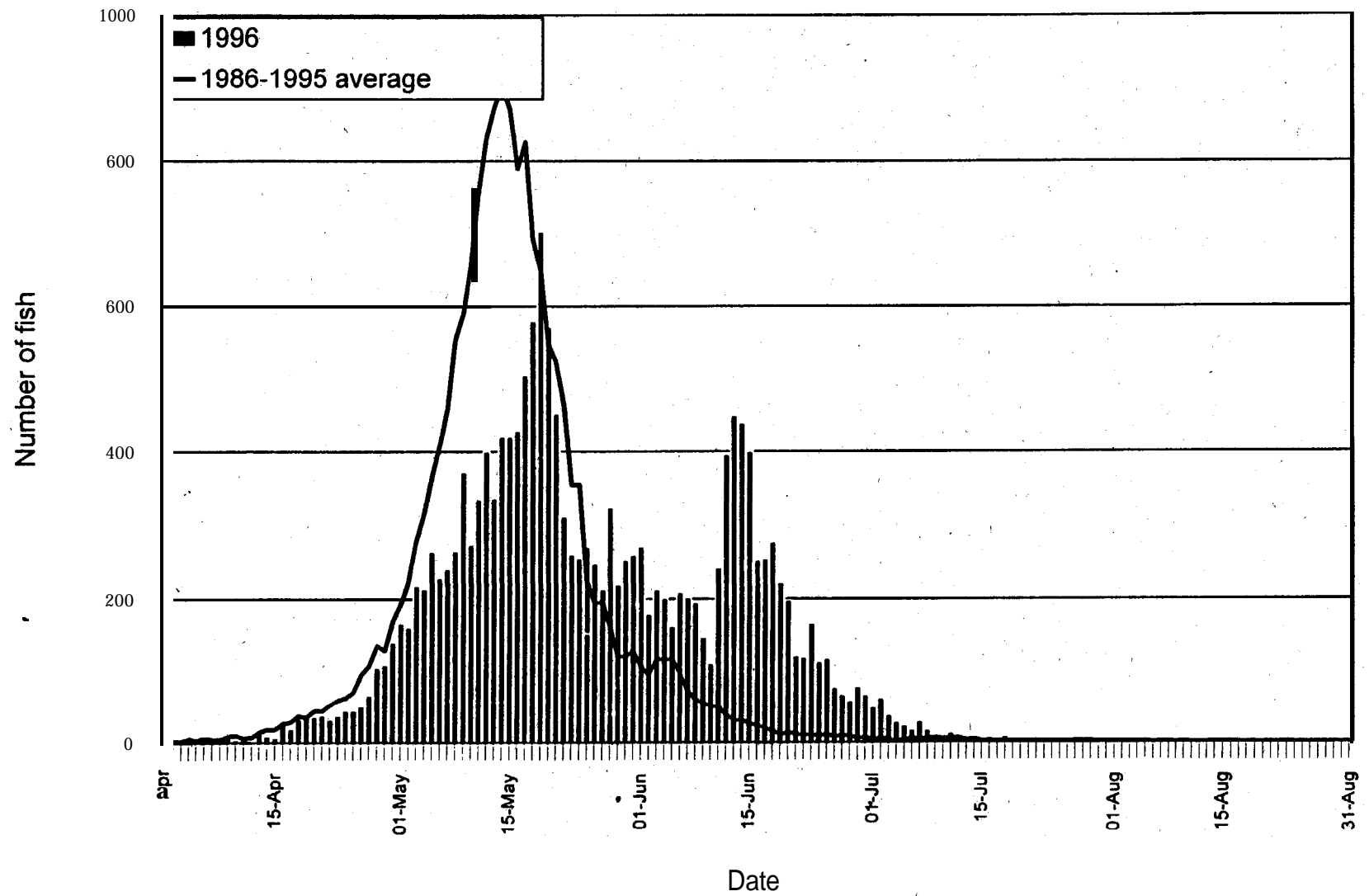


Figure B-4. Daily collected steelhead at Rock Island Dam

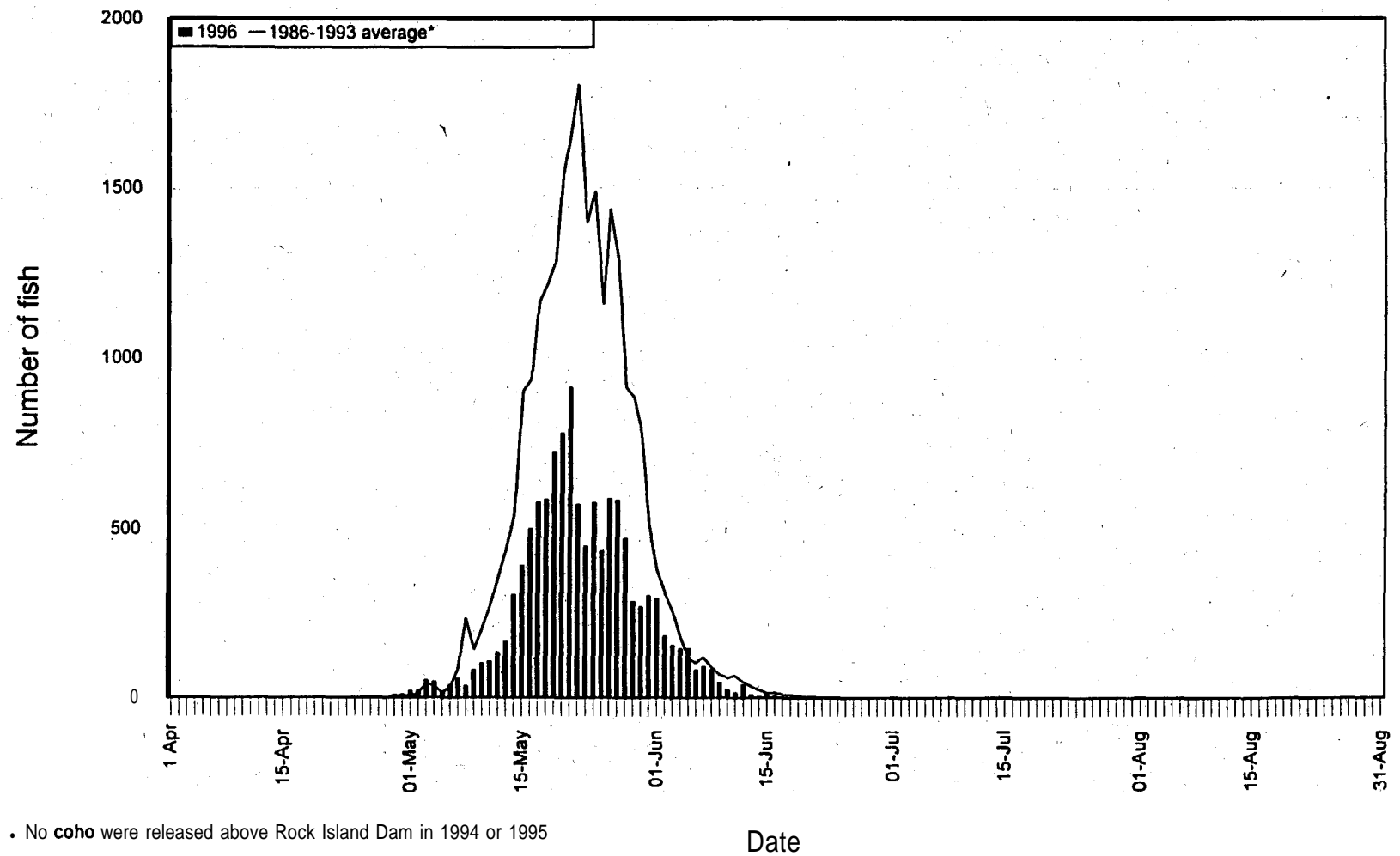


Figure B-5. Daily collection of coho at Rock Island Dam.

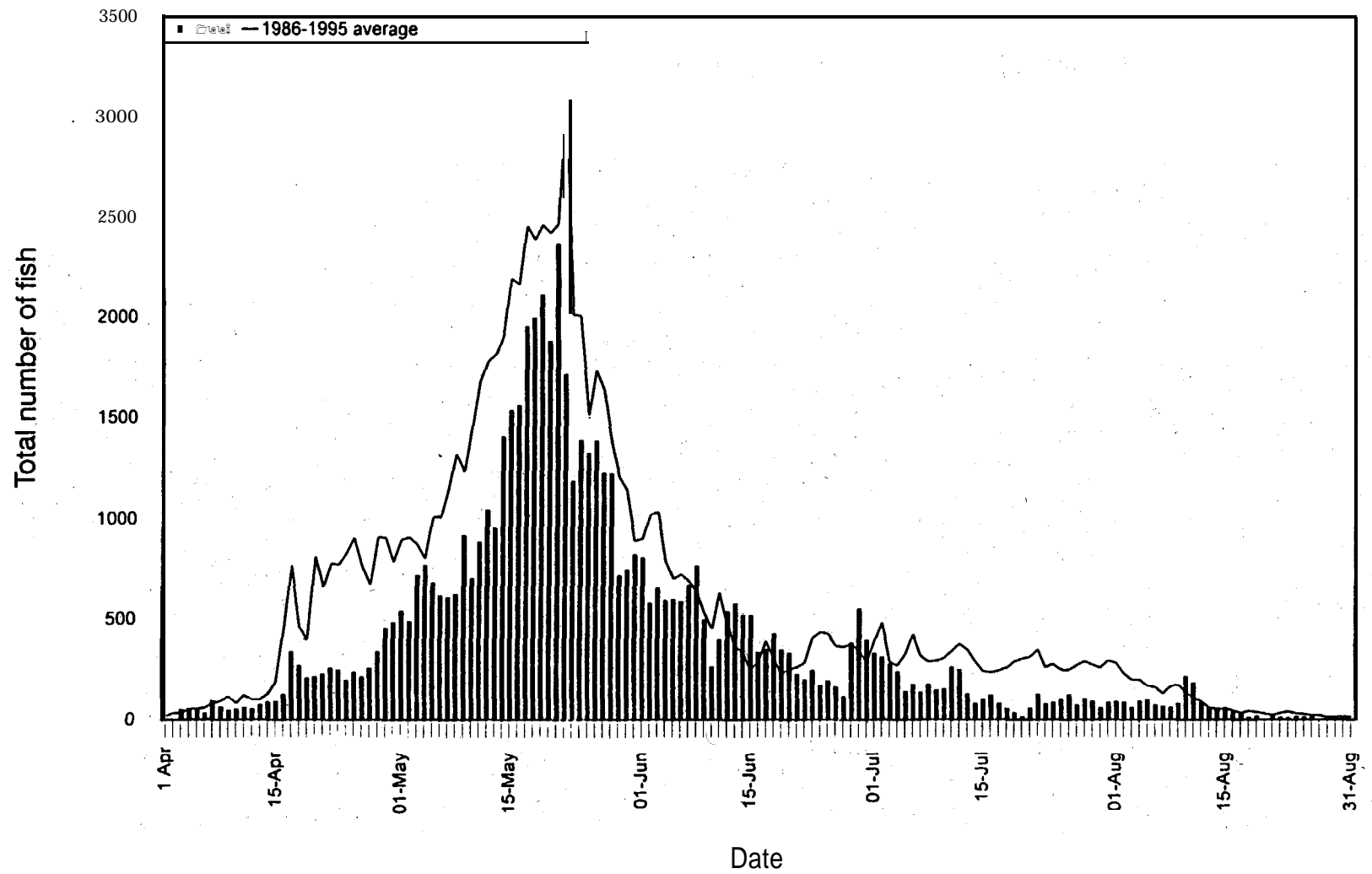


Figure B-6. Daily total collection at Rock Island Dam

Bonneville Power Administration

PO Box 3621 Portland, Oregon 97208-3621

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